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Science 30

Diploma Examination Results
Examiners' Report for June 1996

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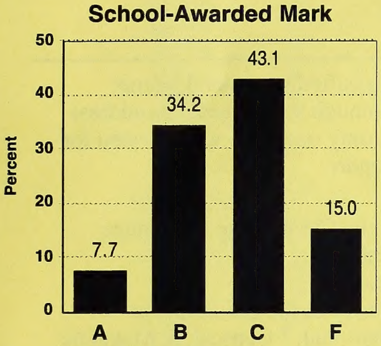

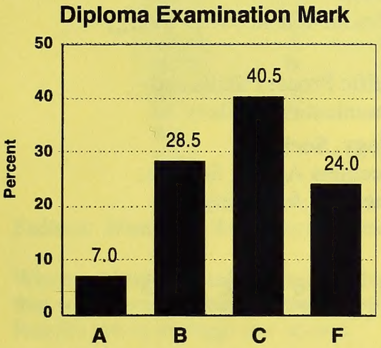

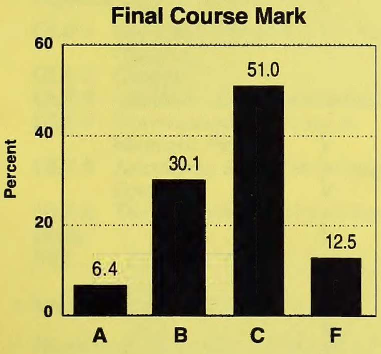

The summary information in this report provides teachers, school administrators, students, and the general public with an overview of results from the June 1996 administration of the Science 30 Diploma Examination. This information is most helpful when used with the detailed school and jurisdiction reports that have been mailed to schools and school jurisdiction offices. An annual provincial report containing a detailed analysis of the combined January, June, and August results is published each year.

Description of the Examination

The Science 30 Diploma Examination consists of 44 multiple-choice questions worth 55%, 12 numerical-response questions worth 15%, and two written-response questions, each worth 15% of the total examination mark.

Achievement of Standards

The information reported is based on the final course marks achieved by 625 students in Alberta who wrote the June 1996 examination.

- 87.5% of these students achieved the acceptable standard (a final course mark of 50% or higher).
- 6.4% of these students achieved the standard of excellence (a final course mark of 80% or higher).

Students showed a reasonable understanding of course content. They performed well in solving single-step problems that required calculations. They demonstrated a good understanding of the risks and benefits associated with various types of energy sources.

Students have shown a steady improvement in communication skills from the first field tests in 1994 to the written-response questions on the June 1996 Diploma Examination. The majority of students are now able to ascertain what the question is asking and can present a well-organized answer that contains specific examples to support their opinions.

Students experienced difficulty in writing about major technologies from the STS component of the course. They also have difficulty with multistep problems, genetic-inheritance calculations, and the interpretation of electrical circuit diagrams.

Approximately 44.5% of the students who wrote the examination were females. Of these, about 72.7% achieved the acceptable standard on the examination, compared with 78.7% of the male population. Approximately 6.1% of the female population achieved the standard of excellence, compared with 7.8% of the male population. The average examination mark achieved by the female population was 58.4%, while the male population achieved an average mark of 60.2%.

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Student Evaluation

Alberta
EDUCATION

Provincial Averages

- The average school-awarded mark was 61.5%.
- The average diploma examination mark was 59.4%.
- The average final course mark, representing an equal weighting of the school-awarded mark and the diploma examination mark, was 60.8%.

Results and Examiners' Comments

This examination has a balance of question types and difficulties. It is designed so that students achieving the acceptable standard will obtain a mark of 50% or higher, and students achieving the standard of excellence will obtain a mark of 80% or higher.

In the following table, diploma examination questions are classified by question type: multiple choice (MC), numerical response (NR), and written response (WR). The column labelled "Key" indicates the correct response for multiple-choice and numerical-response questions. For numerical-response questions, a limited range of answers was accepted as being equivalent to the correct answer. For multiple-choice and numerical-response questions, the "Difficulty" indicates the proportion (out of 1) of students answering the question correctly. For written-response questions, the "Difficulty" is the mean score achieved by students who wrote the examination.

Questions are also classified by general learner expectations. Even though some questions address more than one GLE, only one GLE was selected for the purpose of this report.

Knowledge:

GLE 1	Nervous, Circulatory, & Immune Systems
GLE 2	Genetics
GLE 3	Chemistry & the Environment
GLE 4	Gravitational, Electrical, & Magnetic Fields
GLE 5	Astronomy & the Electromagnetic Spectrum
GLE 6	The Production & Use of Energy

Skills:

SPSC	Scientific Process Skills and Communication Skills

Science, Technology, Society:

STS	Connections Among Science, Technology, & Society

Blueprint

Question	Key	Difficulty	GLE 1	GLE 2	GLE 3	GLE 4	GLE 5	GLE 6	SPSC	STS
NR1	1324	0.482	√							
MC1	D	0.490	√							
MC2	A	0.864	√							
MC3	B	0.690	√							
MC4	B	0.755	√							
MC5	C	0.634	√							
NR2	25	0.389		√					√	
MC6	C	0.318		√						
MC7	C	0.766		√						
MC8	C	0.536		√						√
MC9	A	0.747	√							
MC10	A	0.606						√		
MC11	B	0.483						√	√	
MC12	A	0.445						√	√	
NR3	2.39	0.093						√	√	
MC13	D	0.723						√		
MC14	A	0.571				√				√
MC15	B	0.762						√	√	√
MC16	D	0.765						√		
NR4	4123	0.246						√		√
MC17	B	0.549						√		√
MC18	D	0.766						√		√
MC19	D	0.757						√	√	√
MC20	A	0.374						√		√
MC21	A	0.806						√	√	

Question	Key	Difficulty	GLE 1	GLE 2	GLE 3	GLE 4	GLE 5	GLE 6	SPSC	STS
MC22	A	0.478			√				√	√
MC23	D	0.274			√					√
NR5	1.6	0.562			√				√	
NR6	2314	0.552			√					
MC24	D	0.800			√				√	√
MC25	C	0.659			√				√	
NR7	2.21	0.114			√				√	
MC26	A	0.888	√							√
MC27	A	0.574			√					√
MC28	D	0.674			√				√	√
MC29	A	0.710				√			√	√
MC30	A	0.616				√				
MC31	B	0.794					√		√	
MC32	D	0.808					√			√
MC33	B	0.862					√		√	
NR8	1432	0.509					√			
MC34	C	0.454					√		√	
MC35	C	0.542					√			
MC36	A	0.934					√			
MC37	A	0.514				√				
MC38	D	0.822						√		√
NR9	35	0.736						√	√	√
MC39	B	0.723					√			√
MC40	D	0.398				√			√	√
NR10	18.3	0.843				√			√	
NR11	7.06	0.424				√			√	√
NR12	2.04	0.214						√	√	
MC41	A	0.667		√					√	√
MC42	B	0.482		√					√	√
MC43	B	0.538	√							
MC44	B	0.541	√							
WR1		0.667							√	√
WR2		0.482							√	√

Subtest: Multiple Choice and Numerical Response

When analyzing detailed results, please bear in mind that subtest results **cannot** be directly compared. Results are in average raw scores.

- Multiple choice and numerical response: 33.3 out of 56
- General Learner Expectations

GLE 1	Nervous, Circulatory, & Immune Systems	6.6	out of	10
GLE 2	Genetics	3.2	out of	6
GLE 3	Chemistry & the Environment	4.7	out of	9
GLE 4	Gravitational, Electrical & Magnetic Fields	4.7	out of	7
GLE 5	Astronomy & the Electromagnetic Spectrum	5.6	out of	8
GLE 6	The Production & Use of Energy	9.1	out of	16
Skills		27.6	out of	47
STS		28.0	out of	46

- Multiple choice: 28.2 out of 44
- Numerical response: 5.2 out of 12

Subtest: Written Response

Results are in average raw scores.

- Written Response: 14.0 out of 24
- Question 1: 8.0 out of 12
- Question 2: 5.8 out of 12

Numerical Response

2. Cystic fibrosis is a recessive disease. If both parents are carriers, the probability of their offspring having the disease is _________%.

(Record your answer to two digits on the answer sheet.)

Answer: 25

Use the following information to answer the next three questions

The following nuclear reaction occurs in the Sun:

$$4\,{}^{1}_{1}\text{H} \rightarrow {}^{4}_{2}\text{He} + 2\,{}^{0}_{+1}\text{e} + 2\,\gamma + \text{energy}$$

Masses of reactants and products

hydrogen nucleus	${}^{1}_{1}\text{H}$	1.00728 g/mol
helium nucleus	${}^{4}_{2}\text{He}$	4.00150 g/mol
positron	${}^{0}_{+1}\text{e}$	0.000549 g/mol
gamma ray	γ	0.000000 g/mol

11. The type of reaction that occurs in the Sun is a

A. decay reaction
•B. fusion reaction
C. fission reaction
D. thermal reaction

12. When four moles of hydrogen nuclei produce one mole of helium nuclei, the mass lost in the reaction is

•A. 2.65×10^{-2} g
B. 2.21×10^{-2} g
C. 2.99 g
D. 8.03 g

Numerical Response

*Use your **recorded answer** for **Multiple Choice 12** to solve **Numerical Response 3**.*

3. Determine the amount of energy released when four moles of hydrogen nuclei react to produce one mole of helium nuclei. The amount of energy released as a result of the mass lost, expressed in scientific notation, is $\boldsymbol{b} \times 10^{x}$ J. The value of ***b*** is ___ _•_ ___ ___.

(Record your answer to three digits on the answer sheet.)

Answer: 2.39 o

Numerical-response question 2 required students to realize that crossing two carriers is the same as crossing two heterozygous individuals. Once they realized this, they had to calculate the percentage of homozygous-recessive offspring that would result from the cross.

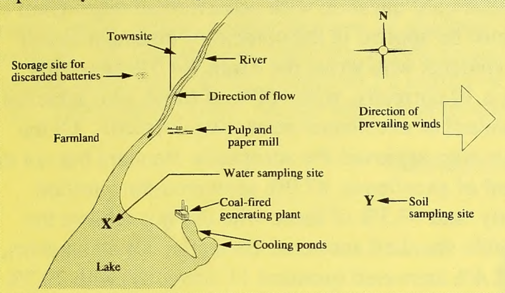
Of the students who wrote the examination, 38.9% were able to find the probability of offspring that would contract cystic fibrosis if both parents were carriers. Of the students achieving the standard of excellence, 81.8% were successful on this question. Of the students achieving the acceptable standard but not the standard of excellence, 41.1% answered the question correctly, and only 11.3% of those who did not achieve the acceptable standard answered correctly.

Multiple-choice questions 11 and 12 and **numerical-response question 3** test students' knowledge about nuclear reactions. Students who chose B or C for question 11 (80.5%) realized that the reaction in the Sun was either fission or fusion. Of all students who wrote the exam, 48.3% answered question 11 correctly, with 75.0% of those who achieved the standard of excellence answering correctly. Of the students achieving the acceptable standard but not the standard of excellence, 50.1% answered the question correctly, and only 35.3% of those who did not achieve the acceptable standard answered correctly.

Students are expected to be able to use the table "Masses of Selected Nuclides and Subatomic Particles" on page 8 of their data booklet to help them determine the mass lost in a nuclear reaction. In question 12, students could just use the table given on the test. Of all students who wrote the exam, 44.5% answered question 12 correctly, with 79.5% of those who achieved the standard of excellence answering correctly. Of the students achieving the acceptable standard but not the standard of excellence, 46.9% answered the question correctly, and only 27.3% of those who did not achieve the acceptable standard answered correctly.

Numerical-response question 3 was linked to multiple-choice question 12. Students were required to apply the formula $E = mc^2$ to the answer they selected in question 12. The answer was expressed as 2.39×10^{x} J. The symbol X was used rather than the actual exponent to avoid confusion among grams, kilograms, Joules, and kiloJoules. Of all students who wrote the exam, 9.3%

An environmental agency hired by a power company monitored the condition of the water and the soil in the area depicted by the following drawing.



22. Phosphates and organic matter were found in the lake water at **site X**. The most likely sources of these substances are the

- **•A.** townsite and farmland
- **B.** farmland and coal-fired generating plant
- **C.** townsite and storage site for discarded batteries
- **D.** pulp and paper mill and coal-fired generating plant

23. The lake was found to have high levels of organochlorides, organophosphates, and carbamates. The presence of these chemicals is most likely caused by the release of

- **A.** bleaches
- **B.** polymers
- **C.** fertilizers
- **•D.** pesticides

Numerical Response

5. Water sampled at **site X** was found to have a pH of 4.80. This represents a hydronium ion concentration $[H_3O^+_{(aq)}]$ of _____ × 10^{-5} mol/L.

(Record your answer to two digits on the answer sheet.)

Answer: 1.6

answered question 12 correctly, with 43.2% of those who achieved the standard of excellence answering correctly. Of the students achieving the acceptable standard but not the standard of excellence, 8.4% answered the question correctly, and only 2.0% of those who did not achieve the acceptable standard answered correctly.

Multiple-choice questions 22 and **23** and **numerical-response question 5** deal with possible pollution problems in a river and lake. On question 22, 30.2% of the students chose D, indicating that they thought pulp and paper mills and coal-fired generating plants were sources of phosphates and organic matter. Of all students who wrote the exam, 47.8% answered question 12 correctly, with 86.4% of those who achieved the standard of excellence answering correctly. Of the students who achieved the acceptable standard but not the standard of excellence, 51.0% answered the question correctly, and only 27.3% of those who did not achieve the acceptable standard answered correctly.

For question 23, 42.9% of the students chose C for the answer. These students probably recognized that fertilizers have a phosphate and an organic component. Only 27.4% of students who wrote the exam answered this question correctly. The results on this question reflect the generally poor understanding of the nature of pesticides and the fact that many of them contain organochlorides such as dioxins and furans.

Numerical-response question 5 offers an interesting comparison of the June 1996 and the January 1996 student populations. For January, when students were required to find the hydronium ion concentration $[H_3O^+_{(aq)}]$ from the pH, 61.9% of the students answered correctly. On this question in June, 56.2% of all students answered this question correctly, with 95.5% of those who achieved the standard of excellence answering correctly. Of the students who achieved the acceptable standard but not the standard of excellence, only 60.1% answered the question correctly, and only 33.3% of those who did not achieve the acceptable standard answered correctly.

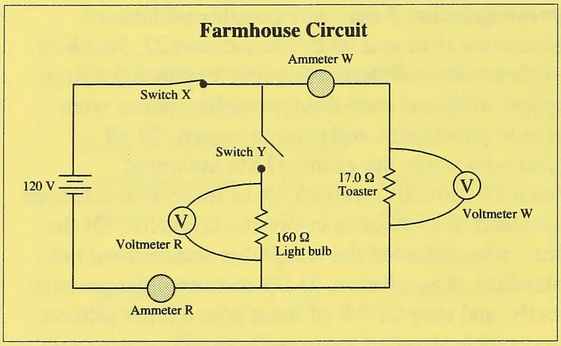
Numerical Response

10. The resistance in a circuit with a 6.00 A current and a 110 V power supply is ___________ Ω.

(Record your answer to three digits on the answer sheet.)

Answer: 18.3

Use the following information to answer the next questions



Numerical Response

11. What is the reading on ammeter W if switch X is closed and switch Y is opened?

Answer: __________ A

(Record your answer to three digits on the answer sheet.)

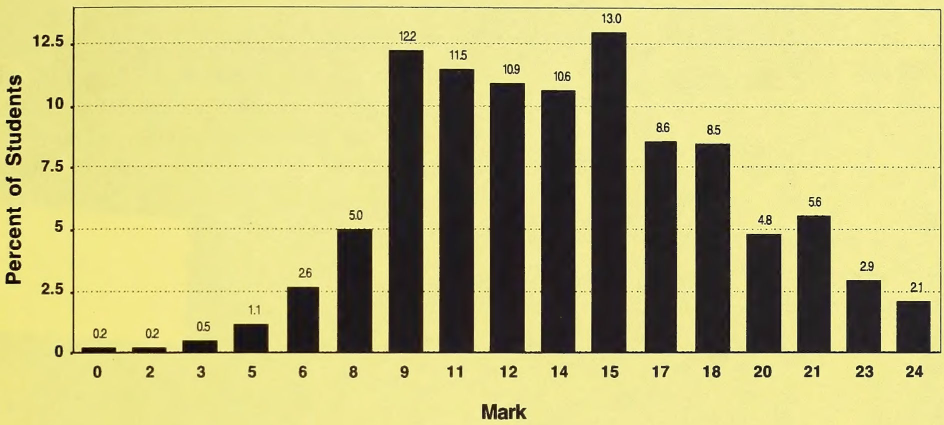
Answer: 7.06

Numerical-response questions 10 and 11 offer a comparison of achievement in using Ohm's Law in a straightforward question with achievement when Ohm's Law must be applied in the context of an actual circuit. Of all students who wrote the exam, 84.3% answered question 10 correctly, with 100% of those who achieved the standard of excellence answering correctly. Of the students who achieved the acceptable standard but not the standard of excellence, 87.9% answered the question correctly, and 69.3% of those who did not achieve the acceptable standard answered correctly. Of all students, only 42.4% answered question 11 correctly, with 79.5% of those who achieved the standard of excellence answering correctly. Of the students who achieved the acceptable standard but not the standard of excellence, only 46.9% answered the question correctly, and only 17.3% of those who did not achieve the acceptable standard answered correctly.

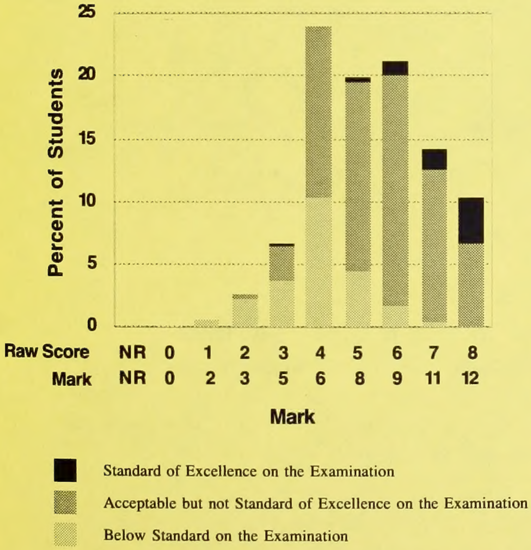
Written-Response Questions

Performance on written-response questions has improved steadily since the beginning of field testing in January 1994, where a large portion of students would not even attempt to answer the written-response questions. Of the students who wrote this examination, only one student received no mark for both written-response questions, 66.9% received 12 marks or more out of 24, and 15.4% received 20 marks or more out of 24. The average mark on the written-response questions was 14.0 out of 24 or 58.4%.

Distribution of Marks for Written Response



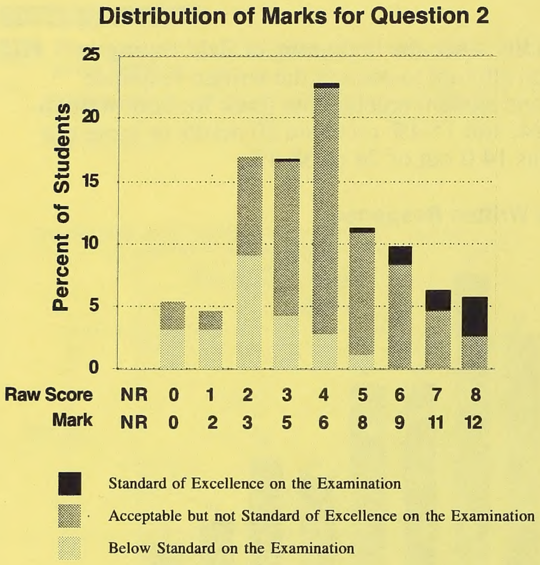
Distribution of Marks for Question 1



Question 1: This process-skill question, which involved the choice of an appropriate site for a coal-burning power plant, was attempted by all but one of the students who wrote the examination.

Part *a* required students to choose the most appropriate site on the map for a coal-burning power plant. Students were required to defend their selection using environmental and economic factors as a basis for their choice. Most students were able to give one or two reasons for choosing a particular site, usually listing acid rain as an environmental problem. Most students considered the prevailing winds and the cost of transportation in their answers.

In Part *b,* most students listed some type of pH testing, but few students went into the buffering effects of soil, mineral leaching, or the use of scrubbers. On this 12-mark question, the average was 8.0 or 66.7%. On this question, 89.9% of the student population achieved the acceptable standard, and 24.8% of the student population achieved the standard of excellence.


Distribution of Marks for Question 2

Question 2: This question was attempted by all students except one. Most students were able to provide a general description of a technology and some of the obvious implications of the technology to society. A few students were able to describe how the technology works. Some students used detailed descriptions and specific examples to present both the advantages and disadvantages of the technology they chose.

On this 12-mark question, the average mark was 5.8 or 48.2%. On this question, 56.0% of the student population achieved the acceptable standard, and 12.0% of the student population achieved the standard of excellence.

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For further information, contact John Drader (jdrader@edc.gov.ab.ca) or Phill Campbell (pcampbell@edc.gov.ab.ca) at the Student Evaluation Branch at 427-0010. To call toll-free from outside of Edmonton, dial 310-0000.

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